Original Research Article

A study of mean platelet volume in acute ischemic stroke

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ABSTRACT

Background: A stroke is defined by the abrupt onset of neurological deficit that is attributable to a focal vascular cause. Because of the growth in the number of ageing population, the burden of stroke is likely to increase automatically in the coming future. Mean platelet volume (MPV), a marker of platelet function is a physiological variable of hemostatic importance. Changes in MPV play a more important role in hemostasis than platelet count. Very few studies has looked at the association between mean platelet volume and ischemic stroke. So, the objectives were to study mean platelet volume in acute ischemic stroke, the role of mean platelet volume as an independent risk factor in acute ischemic stroke and to study the association between MPV and outcome in patients with acute ischemic stroke.
Methods: A cross sectional analytical study was conducted on 60 patients with ischemic stroke identified based on clinical features and MRI of Brain admitted in Mahadevappa Rampure Medical College, Kalaburgi. Mean platelet volume (MPV) on admission was documented and severity of stroke at the presentation and at discharge was assessed using Modified Rankins scale (MRS).
Results: Among 60 patients, 40% of the study patients were aged between 60-80 years and 60% of study population were male and 40% female. The co-morbid conditions present were hypertension in 50%, diabetes mellitus in 41% .The MPV was raised (>12.5fl) in 64 %of the patients. The clinical severity of stroke at presentation as determined by the Modified Rankin's scale (MRS) were moderate (20%), moderately severe (35%) and severe disability in 36.7% of cases. In our study MPV showed statistically significant correlation with Ischemic stroke severity. Clinical outcome as assessed by comparing MRS at admission and discharge with presentation MPV showed 25% moderately, 30% moderately severe and 23% were severely disabled. However, no statistical significance was seen.
Conclusions: We conclude that MPV is raised in acute ischemic stroke and is an independent predictor of the risk of stroke. Higher MPV are associated with more severe stroke and tend to have poorer outcome. Mean platelet volume an indicator of platelet reactivity is a simple and easy test available in panel of hemogram and can serve as a valuable predictor of severity and outcome in acute ischemic stroke patients.

Keywords: Ischemic stroke, Mean platelet volume, Modified rankins scale, Stroke severity

INTRODUCTION

Stroke is one of the main leading causes of morbidity and mortality. It is associated with increased long-term morbidity; Stroke is the commonest cause of death after cardiac diseases and cancer. They cause approximately 200,000 deaths in United States and 334-424/100, 100 deaths every year in India and is a major cause of disability. About 15% to 25% of stroke survivors will get disability permanently, while 20% remain under hospital and nursing care for three months after their stroke. The incidence of stroke increases as age advances and the number of strokes is projected to increase as the elderly population grows, with a doubling in stroke deaths in the

India by the year 2030.[1] It is the sixth leading cause of disability-adjusted life years (DALY; one DALY is one of the lost year of healthy life) in 1990 and is expected to be rank four by the year 2020.[2] Because of the rise in the number of ageing population, the burden of stroke is likely to grow automatically in the near future. Most patients with stroke present with the abrupt onset of a focal neurologic deficit which leads to residual physical, cognitive, and/or behavioral impairments.

Mean Platelet Volume (MPV) is a marker (and possibly a determinant) of platelet function is a physiological variable of hemostatic importance.[3] Large platelets are more reactive, produce more prothrombotic factors and aggregate more readily in response to agonists such as ADP (adenosine diphosphate) and collagen.[4-6] They contain more dense granules and also release more serotonin and beta thromboglobulin than smaller platelets.[7] Mean platelet volume and platelet count are an index of hemostasis. Changes in MPV play a vital role in hemostasis compared to platelet count. Platelet volume is monitored by various intrinsic and extrinsic factors. The mean lifespan of the light platelets is shorter than that of the heavy platelets.[8] Perturbed megakaryocyte platelet hemostatic axis (MPHA) results in the formation of hyper-functional platelets, which also may contribute to the development of vascular disease or an acute thrombotic event such as ischemic stroke.[9] Increase in platelet volume has been reported as a risk factor for acute cerebral ischemia, transient ischemic attacks.[10,11] Higher levels of MPV in the patients with acute ischemic stroke have been signified than in the control subjects.[12] The severity and the poor outcome of ischemic stroke patients with raised MPV has been reported in the literature.[13-15] Ischemic stroke patients with higher MPV tend to have poor outcome than their counterparts with low MPV. Mean platelet volume has been identified as an independent predictor of the risk of stroke.

Though there have been quite a few studies which have demonstrated an association between myocardial infarction and platelet size, very few studies have tried to look at the association between platelet size and ischemic stroke. There are very few documented studies in India comparing the association of mean Platelet volume with acute Ischemic stroke patients; hence an attempt has been made to study the association if any between mean platelet volume and Ischemic stroke in the Indian population.

METHODS

Hospital based cross sectional analytical study included 60 patients above 18 years of age admitted in Basaveshwara Teaching and General Hospital, Kalaburgi attached to Mahadevappa Rampure Medical College, Kalaburgi for a duration of 18 months from November 2018 to April 2020 and this study included patients presenting to the hospital diagnosed with an acute ischemic stroke and satisfying inclusion and exclusion criteria. The patients/caregivers expressing their willingness to participate in the study were enrolled after obtaining a written informed consent. Demographic data such as age and sex were recorded. History of other co-morbid conditions such as hypertension, diabetes mellitus, previous stroke, personal history such as habits of smoking, alcohol consumption was noted.

A thorough physical examination and systemic examination was done. Diagnosis of Ischemic stroke done after fulfilling WHO definition and supported by CT/MRI scans, investigations like MPV and platelet count were done. Evaluation of stroke severity was done based on MRS scoring system. Findings were recorded on predesigned and pretested proforma. The patients with thrombocytopenia, known case of hereditary disorders of large platelets and on medications that reduces platelet count like hydroxyurea, anti-cancer agents etc were excluded from study. The ethical clearance was obtained by Institutional Ethical committee, MRMC, Kalaburgi.

RESULTS

A total of 60 patients with acute ischemic stroke were studied. The mean age was 57.03±17.26 years. The common age group was 60-80 years which was followed 40-60 years.

Table 1: Age distribution.

Age (years)	Frequency (n)	Percentage (%)
20-39	10	16.67
40-59	19	31.66
60-79	24	40
≥80	7	11.66
Total	60	100
Mean±SD	57.03±17.26	
Range	20-99	

Table 2: Gender distribution.

Gender	Frequency (n)	Percentage (%)
Male	36	60
Female	24	40
Total	60	100

In our study male dominated study population with 60% and female with 40%. Male to female ratio was 1;1.15

Table 3: Distribution of cases according to comorbid conditions.

Past history	Frequency (n)	Percentage (%)
DM	25	41.7
HTN	30	50
IHD	5	8.3
Total	60	100

DM- Diabetes Mellitus (41.7%); HTN-Hypertension (50%); IHD -Ischemic Heart Disease (8.3%)

Hypertension was the commonest risk factor in this study group with 50%. Diabetes mellitus being second with 41.7% followed by Ischemic heart disease with 8.3%

Table 4: Distribution of cases according to Modified Rankin's score (MRS).

Modified Rankin's score	Frequency (n)	Percentage (%)
2	5	8.3
3	12	20
4	21	35
5	22	36.7
Total	60	100

The clinical severity of stroke at presentation as determined by the Modified Rankin's score was severe disability in 36.7% of the cases, moderately severe disability in 35% followed by moderate disability in 20% and slight disability in 8% of cases.

Table 5: Comparison of MPV based on Modified Rankin's score (MRS).

Modified Rankin's score	N	Mean	Std. deviation	P-value
2	5	11.18	1.66	
3	12	11.18	1.79	0.024*
4	21	12.02	1.36	
5	22	12.61	1.44	

There is a co-relation between MPV and severity of stroke (on the basis of Modified Rankin's score) with a p value of 0.024 which is statistically significant. Higher values of MPV are associated with severe forms of stroke.

Table 6: Correlation between MRS and other variables.

MRS	Correlation coefficient	P value
Platelets	-0.017	0.898
Sodium	-0.142	0.28
Potassium	-0.225	0.085
Age (years)	0.619	0.001*

In this table we can see positive correlation between MRS and Age, which means as age increases severity of stroke also increases.

This table shows statistically significant association between MPV and DM (p value 0.001) and IHD (p-0.042) which means diabetic and IHD patients have higher MPV.

Table 7: Association between MPV and comorbid conditions.

Comorbid conditions	MPV high n (%)	MPV low n (%)	P value
Diabetes mellitus	24 (64.86)	1 (4.34)	0.001*
Hypertension	23 (62.16)	10 (43.47)	0.157
Ischaemic heart disease	6 (16.21)	0	0.042*

Table 8: Association between MRS and comorbid conditions.

Comorbid conditions	MRS 2 n (%)	MRS 3 n (%)	MRS 4 n (%)	MRS 5 n (%)	P value
Diabetes mellitus	2 (40)	2 (16.67)	10 (47.61)	11 (50)	0.259
Hypertension	1 (20)	5 (41.67)	14 (66.67)	13 (59.09)	0.2
Ischaemic heart disease	0	1 (8.33)	1 (4.76)	4 (18.18)	0.412

No statistically significant association was observed between MRS and comorbid conditions.

MRS at admission and at discharge were compared with admission MPV to see for outcome.25% moderately, 30% moderately severe and 23% were severely disabled with one death at hospital course.

Table 9: Comparison of admission and discharge MRS scores.

Modified Rankin's score	Admission n (%)	Discharge n (%)
1	-	2 (3.33)
2	5 (8.3)	10 (16.67)
3	12 (20)	15 (25)
4	21 (35)	18 (30)
5	22 (36.7)	14 (23.33)
6	-	1 (1.67)
Total	60 (100)	60

P=0.23

DISCUSSION

This study was carried out in Basaveshwara Teaching and General Hospital, Kalaburgi attached to Mahadevappa Rampure Medical College, Kalaburgi.

In this study 60 patients with ischemic stroke were studied among which 40% of the study patients were aged between 60 to 80 years followed by 40 to 60 years. The mean age among patients was 57.03±17.26 years. These observations showed that, acute ischemic stroke in this study was common in elderly group. A study to assess the role of MPV in ischemic stroke by Shah et al has reported

mean age as 58 years which is similar compared to present study.[16]

In present study, acute ischemic stroke was widely prevalent among 60% of males and 40% in females. The male to female ratio was 1.5:1 .These findings suggest male dominance in acute ischemic stroke patients which was consistent with a study by Shah et al.[16]

Out of the many risk factors for stroke, hypertension was noted in 50% of the patients followed by 41.7% of diabetes mellitus and Ischemic heart disease of 10%. Similarly hypertension was the most prevalent risk factor in study by Muscari et al with 84.7% and 82.7% in Pikija et al.[17,18]

The platelet parameters assessed was mean platelet volume (MPV). MPV was raised (i.e more than or equal to 12.5fl) in 63.3% of study population and has got statistically significant correlation with ischemic stroke with a "p" value of 0.024 and The results of our study are consistent with study by Neki et al which said that MPV has got significant correlation with acute ischemic stroke as independent risk factor.[19]

Bath et al in a sub study of the PROGRESS trial followed 3134 individuals for an average of 3.9 years and assessed the association of MPV with the risk of stroke and found significantly raised MPV in such patients.[20] In this study, stroke rates were greater among individuals with higher measurements of MPV, both for overall (P for trend across fifths of MPV=0.01) and for ischemic stroke alone (p=0.01). With adjustment for population of recruitment and measurement error, the strength of the overall association was such that each 1-fL increase in usual MPV was associated with a 12% (95% CI, 4% to 20%) increased relative risk of stroke. The study identified MPV as an independent predictor of the risk of stroke among high-risk individuals. The measurement of MPV may add useful prognostic information for clinicians managing patients with a history of cerebrovascular disease.

Systematic review and meta-analysis conducted by Sadeghi et al showed seventeen results of the 27 studies revealed that patients with stroke had higher MPV than controls ten studies found no difference in MPV between patients and controls and two studies demonstrated a higher MPV in the control group.[21]

In our study we also found that the mean platelet volume was significantly high (>12.5fl) in patients with history of diabetes mellitus compared to non-diabetic patients (p=0.001).These findings confirm the positive association between mean platelet volume (MPV) and acute ischemic stroke in patients with diabetes mellitus. Study conducted by Priyanka et al are consistent with our results, which showed acute Ischemic stroke in diabetics is significantly associated with raised MPV also, study done by Meena.p et al.[23] says MPV was higher in patients with stroke and diabetes mellitus with a suggestive significance (p<0.001) when compared to controls.[22] Shah et al reported a

significant correlation between MPV and the degree of glycemic control only in diabetic patients. This result suggests that the positive relationship between an increased glucose level and increased MPV is a unique phenomenon of diabetes itself.[16]

The clinical severity of stroke at presentation was determined by the Modified Rankin's scale and severe disability was seen with 36.7% of the cases, moderately severe disability in 35% followed by moderate disability in 20% and slight disability in 8% of study population .

Mean duration of stay at hospital was 5.4 days. The association of MPV with severity of stroke was determined by comparing the modified Rankin's score with corresponding mean values of MPV in each group. MPV showed a 'p' value of 0.02 which was statistically significant. Ghahremanfard et al conducted similar studies and found out MPV and platelet count are associated with stroke severity and have a high predictive value for discriminating severe from mild ischemic stroke.[24] Thus, we can use the MPV and platelet count as a prognostic marker in acute ischemic stroke.

Greisenegger et al. conducted study which shows Patients within the highest quintile of MPV had a significantly higher risk of suffering a severe stroke, defined as modified Rankin Scale score of 3 to 6, compared with patients within the lowest quintile.[25] This association remained significant after adjustment for possible confounding factors.

In our study to assess the clinical outcome of the patients at discharge, MRS was evaluated to see the dependency i.e MRS (3-5), among 60 patients; one patient died during the hospital stay (MRS-6), 25% of patients were moderately disabled (MRS-3), 30% of patients were moderately severe (MRS-4) and 23.3% were severely disabled (MRS-5). 78% of the patients whose MPV was high at admission had poor outcome on discharge as they were dependent on attenders causing prolonged morbidity. However when MRS at admission and discharge were compared with MPV, no statistical significance was seen (p-0.23).

Studies done by Bassiouny et al showed MPV was an independent predictor of poor short-term outcome of acute stroke after controlling for confounders like diabetes mellitus.[26] Staszewski et al conducted a study whose results suggest that patients within middle or high tertiles(MPV >7.29fl) of MPV on admission represent the highest risk for larger infarcts on admission and worse outcome.[27]

Limitations

This study has few obstacles that need to be considered assessing the results. We measured MPV first at admission, and did not measure serially at different point of stroke evolution or discharge. We did not follow up the case after discharge for total outcome of the patient in

terms of morbidity. And our study population was 60 patients only. Therefore, according to our results, we recommend further larger studies to investigate the role of this index as a predictive factor and prognostic tool in the severity of ischemic stroke or mortality.

CONCLUSION

Based on our study we concluded that MPV is raised in Acute Ischemic stroke and is an independent predictor of the risk of stroke among high-risk individuals. Higher MPV are associated with more severe stroke, based on MRS (3-6) compared to lower MPVs and tend to have poorer outcome interms of morbidity and mortality. MPV was significantly raised in patients with Diabetes and DM being a pro coagulant state, patients are at risk of thrombotic events. Mean platelet volume an indicator of platelet reactivity is a simple and easy test available in panel of hemograms and can serve as a valuable predictor of severity and outcome in acute ischemic stroke patients.

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